# A mathematical model for Rift Valley fever transmission dynamics

Bernard Bett, International Livestock Research Institute

One Health for the Real World: Zoonoses, Ecosystems and Wellbeing
London, UK
17–18 March 2016

A research programme co-funded by DFID, NERC & ESRC and accredited by LWEC

# Acknowledgements

John Gachohi, Tabitha Kimani,
International Livestock Research Institute, Nairobi

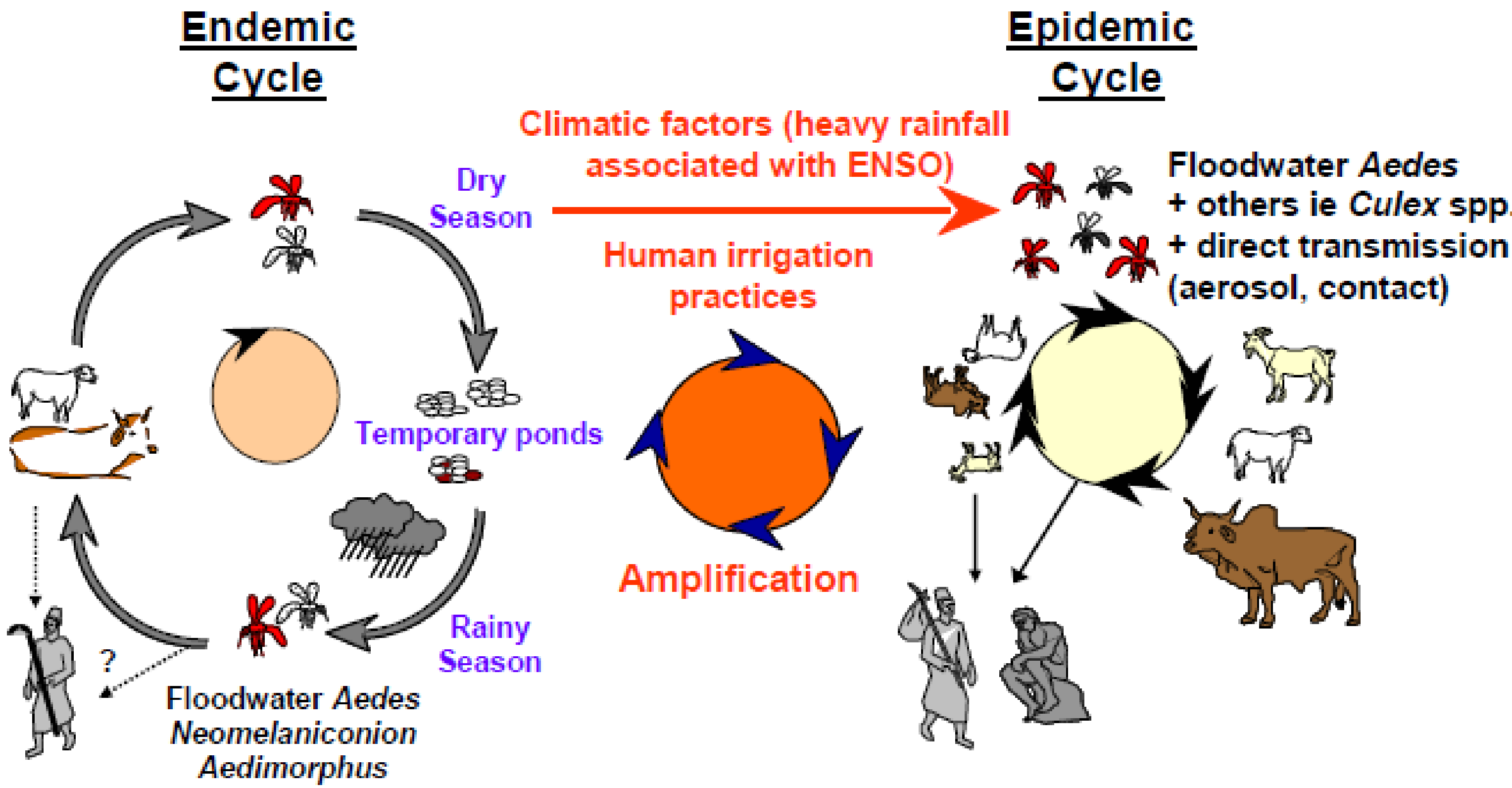
*Dynamic Drivers of Disease in Africa REF:NE/J001422/1"*

# Introduction

- Rift Valley fever:
    - Caused by arthropod-borne zoonotic RNA virus
    - Primarily affects livestock with spill-overs to people
    - Associated with substantial impacts on livestock production and trade

- We used a mathematical to:
    - Investigate RVFV transmission dynamics
    - Analyse competing prevention and control strategies

# RVFV transmission cycle

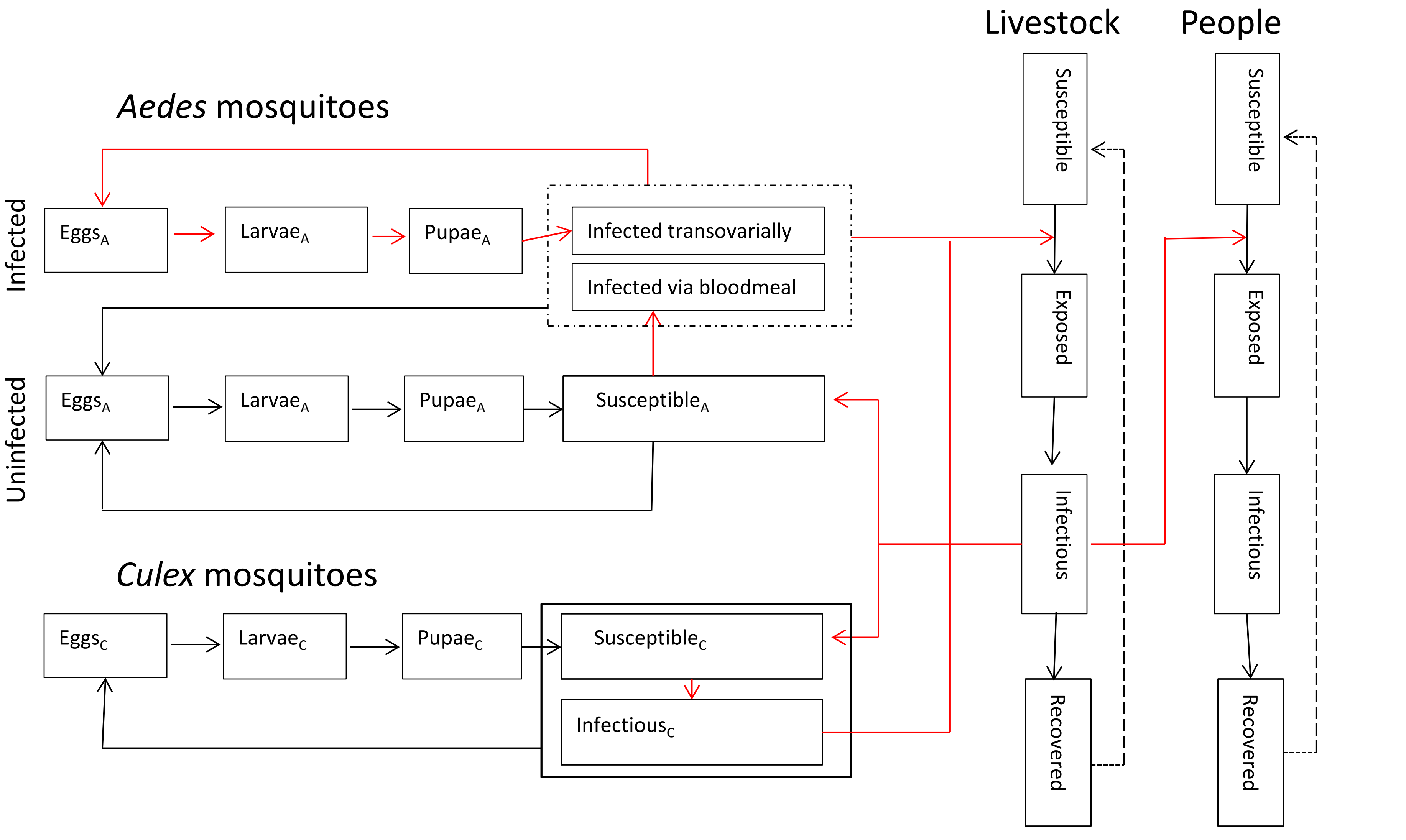


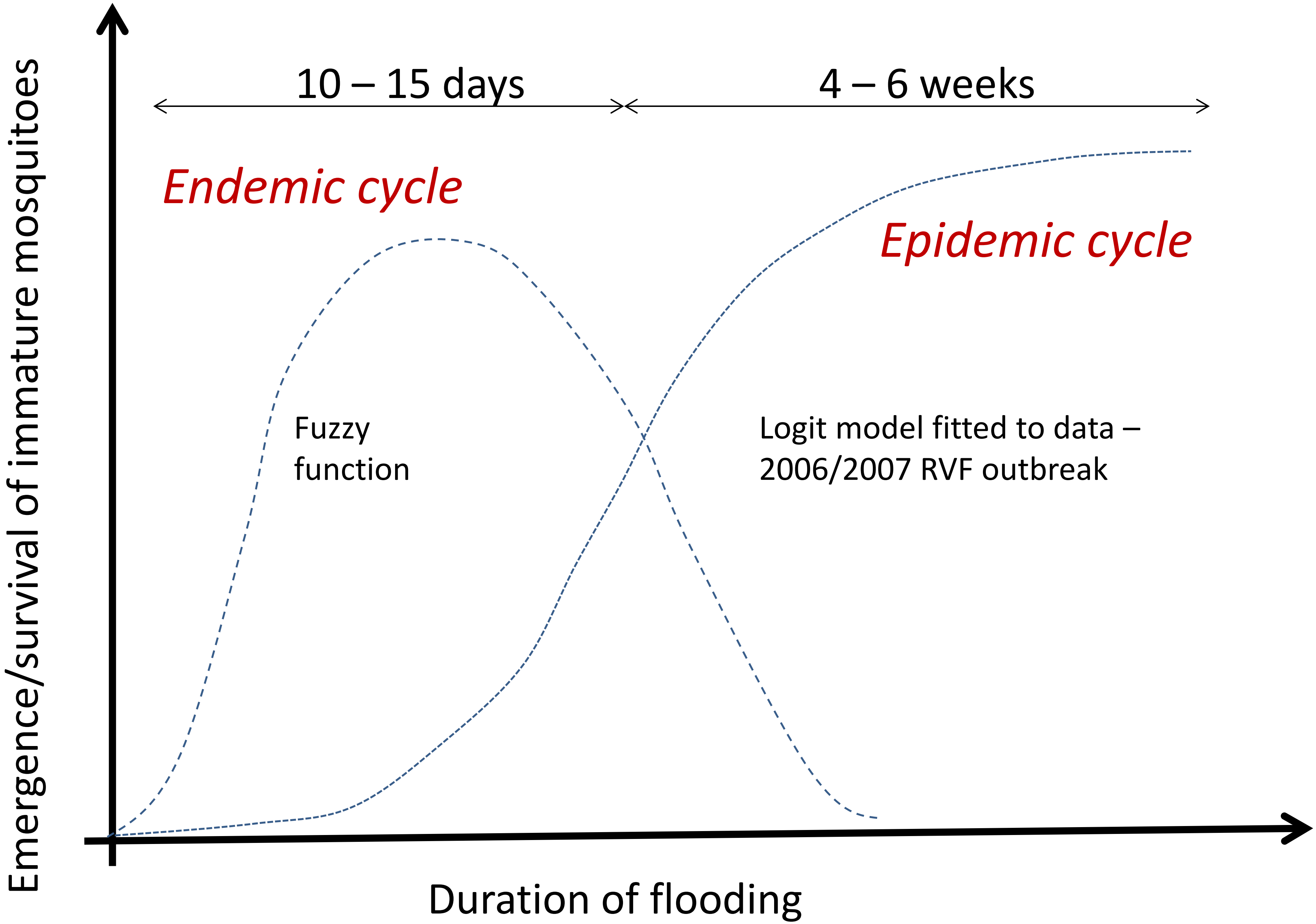

The virus persists during dry seasons and inter-epizootic periods through vertical transmission, inside drought resistant floodwater *Aedes* eggs.

Flooding results in a mass-hatching of *Aedes* eggs, some of which are infected, leading to a new RVF outbreak.

*EFSA, 2005*

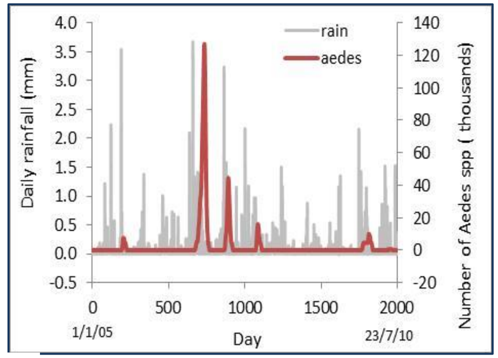
# Model structure

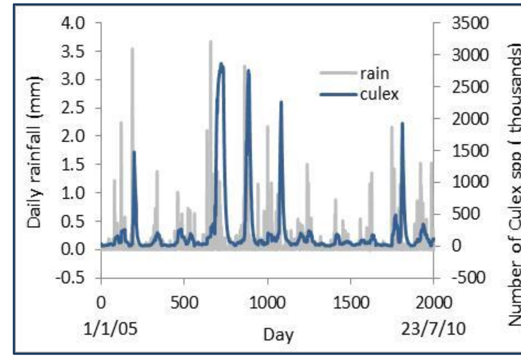


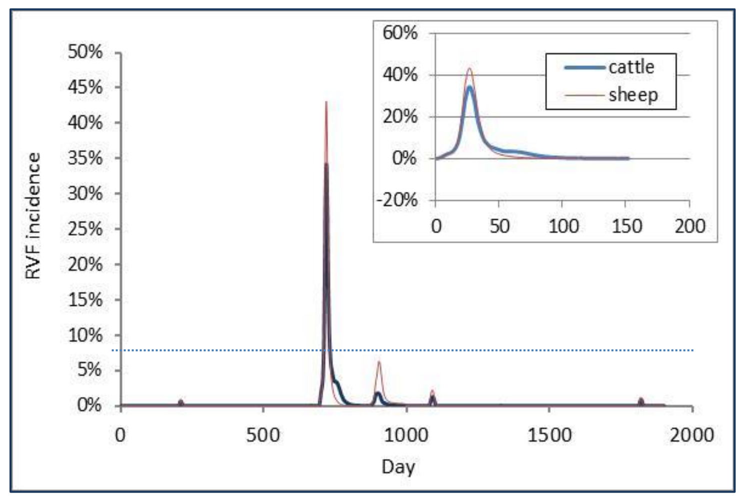

10 – 15 days
4 – 6 weeks
Endemic cycle
Epidemic cycle
Fuzzy function
Logit model fitted to data – 2006/2007 RVF outbreak
Emergence/survival of immature mosquitoes
Duration of flooding

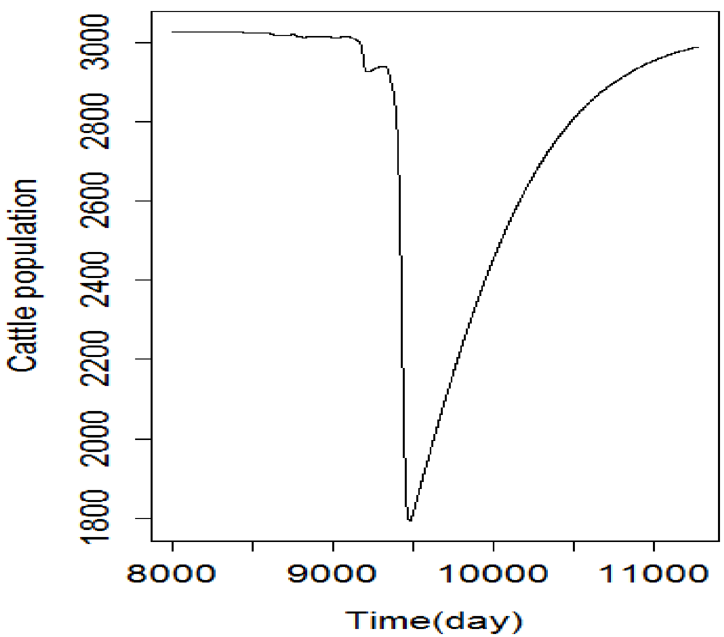
# Model components

Rainfall – satellite data and statistical modelling

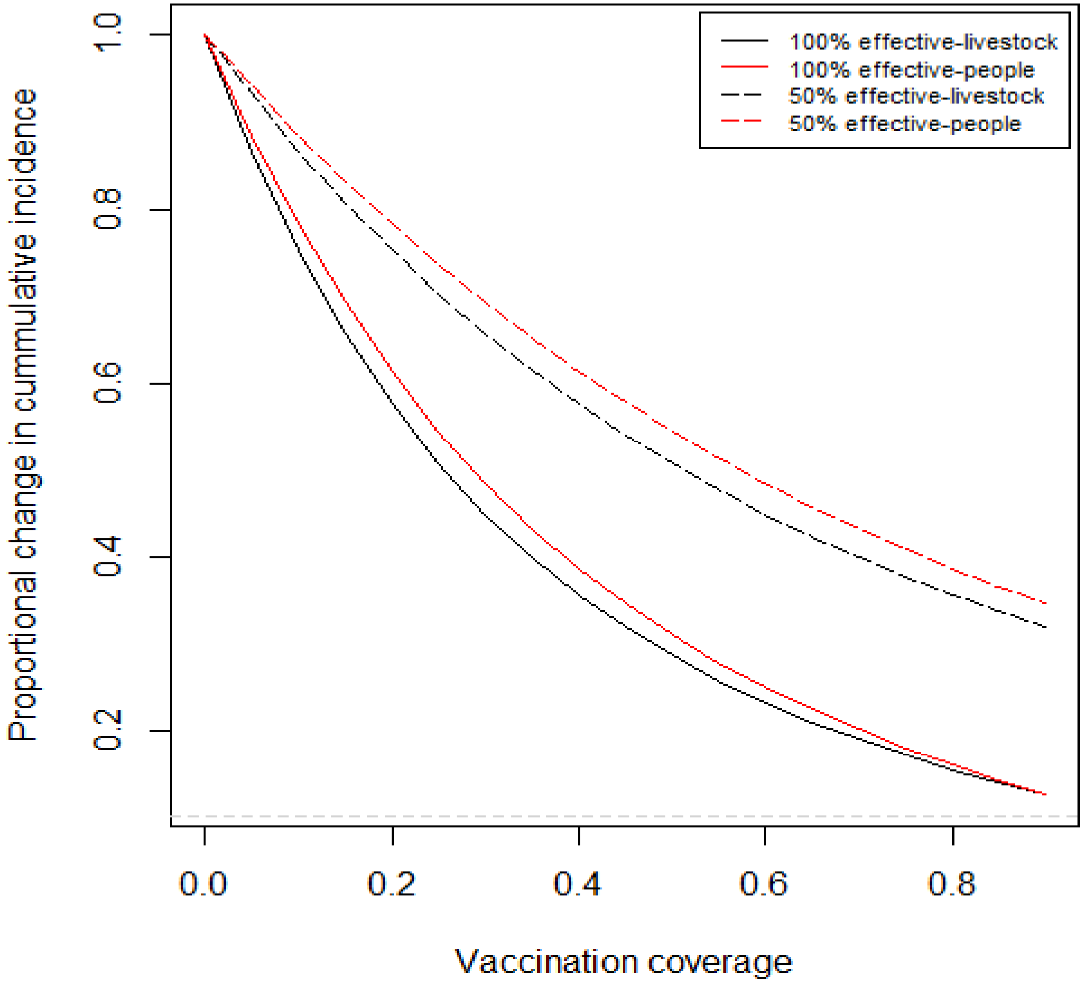


# One-Health interventions:
## reactive vaccination 2 months before an outbreak

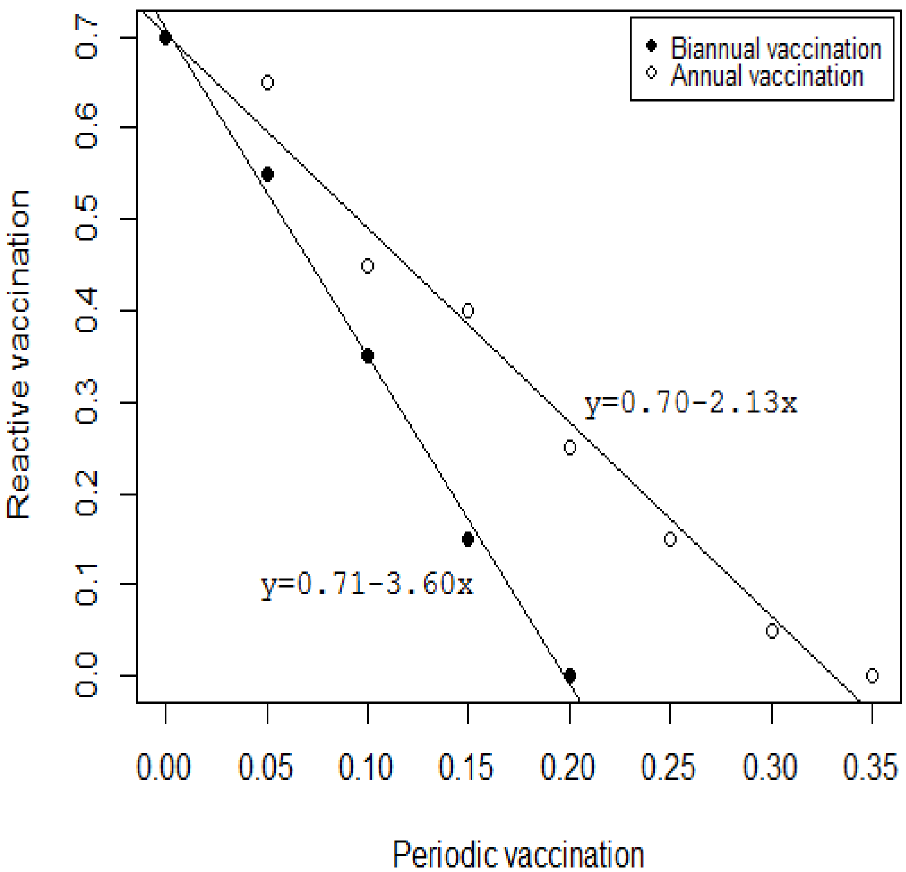



- Vaccinating animals – beneficial effects in humans
- Efficacy of the vaccine

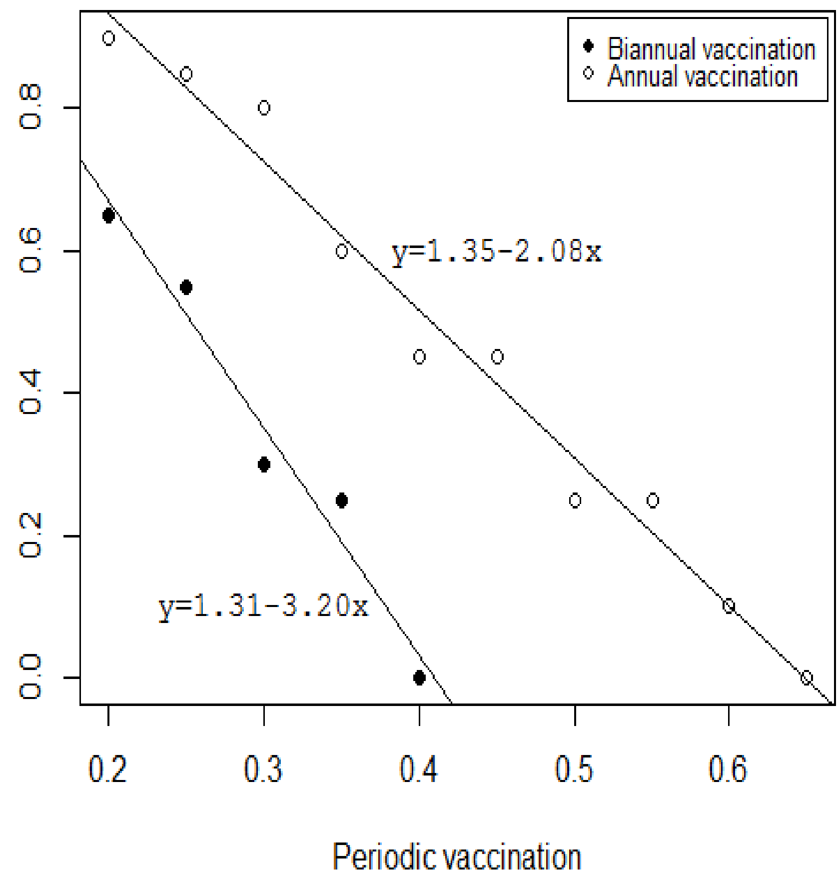
# Reactive and prophylactic vaccination

What vaccination levels are required to stop an outbreak (reduce incidence <10%)

100% efficacy




50% efficacy



# Vector control

- Analysed but found not to be feasible
  - Need to sustain high vector mortality levels for prolonged time to achieve impact

## Summary

- Models can provide informative insights e.g. levels of effort required to control a disease
- Discussions with policy makers on control options
- RVF – scanty data as the disease occurs infrequently

A research programme co-funded by DFID, NERC & ESRC and accredited by LWEC

This work, Dynamic Drivers of Disease in Africa Consortium, NERC project number NE-J001570-1, was funded with support from the Ecosystem Services for Poverty Alleviation (ESPA) programme. The ESPA programme is funded by the Department for International Development (DFID), the Economic and Social Research Council (ESRC) and the Natural Environment Research Council (NERC).